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Assumption 1:

A fixed route structure, to include required speeds along each route segment, will be used in the terminal area.

Rationale:

Fixed routes with speed schedules:

(1) have show to provide system-wide stability if only small speed perturbations are allowed about this schedule.
(2) don't require the communication of intent information.
(3) simplify time and distance calculations (and estimation errors).
(4) eliminate large speed differences between aircraft.
(5) reduce the uncertainty of ATC and flight crews on the intent of other traffic.
(6) allow for the potential of mixed-equipage operations, with the ADS-B-only aircraft following the speed schedule.

Assumption 2:

Largely dissimilar aircraft (i.e., jets versus turboprops) will be separated either vertically or laterally until such a time that their respective speed performance is compatible.

Rationale:

This is how today's terminal procedures work. If it ain't broke, don't fix it.

Assumption 3:

Aircraft will be allowed to "slightly" vary their speed along the route segment to compensate for spacing errors.

Rationale:

As in assumption 1:

(1) have show to provide system-wide stability if only small speed perturbations are allowed about this schedule.
(2) eliminate large speed differences between aircraft.
(3) reduce the uncertainty of ATC and flight crews on the intent of other traffic.

Assumption 4:

Each aircraft will broadcast their heading, airspeed, and planned final approach speed (the planned speed inside the FAF). This broadcast will begin prior to entering the TRACON. The broadcast may use the ADS-B on-condition message frequency (~once every 30 seconds).

Rationale:

Heading and airspeed information will allow the ground tools / airborne tools to greatly enhance their wind predictions along the planned paths. Wind error has been found to be one of the largest contributors of ETA errors in the terminal area. Planned final approach speed is required to calculate the time / distance offset required at the FAF for the precision final spacing of aircraft with dissimilar final approach speeds.

Assumption 5:

If available, each aircraft will broadcast their RTA to the metering fix, prior to entering the TRACON. The broadcast may use the ADS-B on-condition message frequency (~once every 30 seconds).

Rationale:

This may be needed to decrease the arrival error at the TRACON boundary.

Issue:

Is this a requirement? How much error is allowed in meeting the RTA?

Assumption 6:

Aircraft will be delivered to the metering fixes in a manner as to not create a scheduling conflict at the TRACON boundary.

Rationale:

This is a basic premise of this concept. A scheduling conflict at the TRACON boundary will probably not be able to be handle only by a small speed adjustment. While lateral path maneuvering is a requirement for the n-state application of this concept, maneuvering is considered to be a “problem-fixer.” The nominal case for this application, and the one to be explored first, requires accurate, conflict-free delivery.

Issue:

The requirement will must include a requirement that the delivery will not create a conflict within the TRACON. This will require landing sequencing and pair-wise knowledge (see assumption 7) prior to reaching the TRACON.

Assumption 7:

The terminal area ground tool (TMA?), using the fixed-route with speed schedules, aircraft RTAs to the metering fixes, aircraft planned final approach speeds, aircraft wake vortex categories, and current wind information will:

(1) calculate an ETA to the planned landing runway for each aircraft. Note that the ETA will include pair-wise constraint considerations, e.g., wave vortex and final approach speed differences will be included in this calculation.

(2) determined the sequence number (based on the ETA) for each aircraft.
(3) provide a sequence to each aircraft.
(4) the sequence number implies an equivalent, relative RTA.

Rationale:

This is a basic premise of this concept. By providing a conflict-free sequence for each aircraft, only very small speed adjustments should be necessary for each aircraft to achieve an uneventful, precision arrival at the planned runway.

Issue:

Errors in arrival RTAs and TRACON relative ETAs (e.g., a poor wind estimate leading to a error between the planned and actual along-route time) need to be examined.

Assumption 8:

The sequence number provided to each aircraft will only be for the aircraft you will eventually land behind. It is assumed that the conflict-free metering, route speed schedules, and the normal separation provided between aircraft pairs (where the plan is to insert an aircraft between them), will naturally provide adequate separation prior to merging behind the aircraft you will eventually follow for landing.

Rationale:

Because only one “follow” clearance is issued, this significantly reduces both ATC and flight crew workload. This is an extremely important consideration for flight crew workload in terminal area airspace.

Issue:

Errors in arrival RTAs and TRACON relative ETAs (e.g., a poor wind estimate leading to a error between the planned and actual along-route time) need to be examined. This examination must consider:
(1) loss of separation / spacing (actual or perceived) behind a leading aircraft that is not your specific “sequenced” aircraft.
(2) loss of separation / spacing (actual or perceived) behind a merging aircraft that is not your specific “sequenced” aircraft.

Assumption 9:

Once an aircraft sequence is provided and that aircraft ADS-B broadcast becomes available, ownship will begin spacing on that aircraft. Prior to this condition being met, the aircraft will follow the route speed schedule. Active spacing will be gain-scheduled. The baseline for the gain-schedule is the nominal, route speed schedule. The gain-schedule will be based on the distance / time to the runway (the closer to the runway, the greater the influence of spacing) and the calculated spacing error (the greater the error, the greater the influence of spacing).

Rationale:

This technique should enhance system-wide stability. In addition, previous ad hoc studies have shown that spacing errors calculated over long intent periods are often invalid, leading to aircraft correcting errors that really didn't exist.

Issue:

Errors in arrival RTAs and TRACON relative ETAs (e.g., a poor wind estimate leading to a error between the planned and actual along-route time) need to be examined. This examination must consider the impact of early, less aggressive spacing on both the loss of separation / spacing behind a leading aircraft or a merging aircraft that is not your specific "sequenced" aircraft.

Assumption 10:

An accurate, near-term wind forecast is critical to this concept. It is assumed that the ground tool will assimilate the broadcast ADS-B data (position, altitude, ground speed, ground track, airspeed, and heading) and derive a accurate wind profile for the terminal area. This wind data will be used by the ground tool in the calculation of terminal area route ETAs. Additionally, this information will be broadcast to the aircraft for use by the airborne spacing tools.

Rationale:

Accurate wind data is essential in calculating relative arrival ETAs, especially when sequenced aircraft on different arrival routes. This wind data is required on the aircraft for a similar reason.

Issue:

How much error in the wind estimation can the non-maneuvering portion of this concept tolerate? How much wind information is required by each aircraft? How will that information be transmitted (discrete-address or broadcast)?